MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2019/2020

PPH0125 –MECHANICS

(Foundation in Engineering)

14 OCTOBER 2019
02.30 p.m. - 04.30 p.m.
(2 Hours)

INSTRUCTIONS TO STUDENT

1. This question paper consists of 6 pages excluding the cover page with 5 Questions only.

2. Attempt **ALL** questions. All questions carry equal marks and the distribution of the marks for each question is given.

3. Please write all your answers in the Answer Booklet provided.

4. All necessary working steps/concept must be clearly shown.

QUESTION 1 (20%)

a) In **Figure 1 (a)** shows a motorcycle rider is moving horizontally and taking off from a cliff of 5 m above the ground. Upon taking off, the velocity of the vehicle is 30 m/s. What is the horizontal distance, x, of the motorcycle when it touches the ground from the place where he took off?

(10 marks)

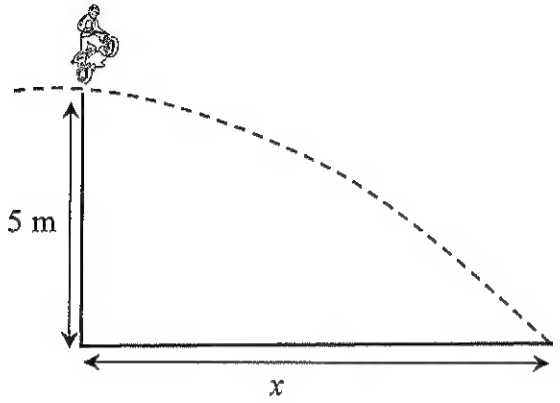

Figure 1 (a)

b) **Figure 1(b)** shows a man is bending down to carry a 60 N load. From the figure, it can be seen that his hip joint is pivoted as he bent down. A free body diagram has been constructed to show the weight of his upper torso which weigh at 250 N and act through G point. Find

i) the tension of back muscle P. (4 marks)

ii) the compression F_x on the back bone. (3 marks)

iii) the vertical reaction F_y on the hip joint. (3 marks)

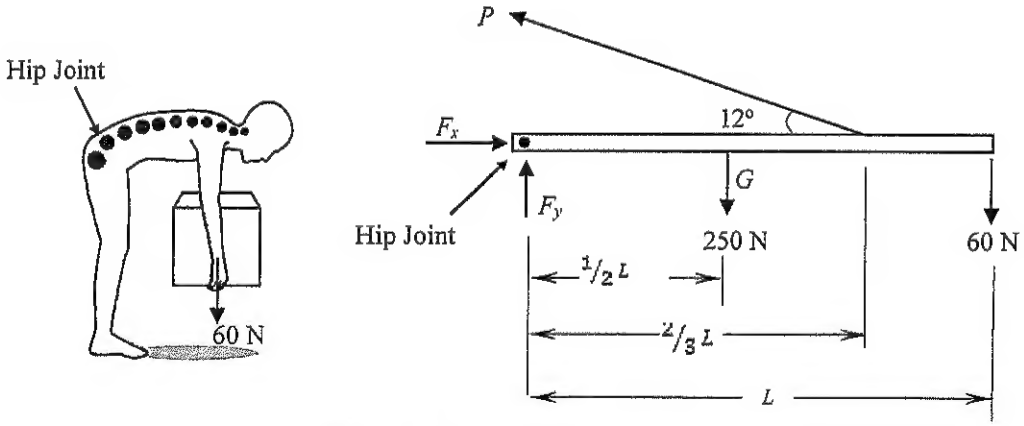

Figure 1 (b)

Continued ...

Question 2 (20%)

a) A particle shown in **Figure 2 (a)** move in a circle with radius 0.25 m at constant speed. It takes 5 s to move from point *A* to *B*.

i) What is the angular distance in radians from point *A* to *A* in one cycle? How far it travels?

(2 + 2 marks)

ii) What is the angular velocity of the particle?

(3 marks)

iii) What is the speed of the particle when it is at point *B*?

(3 marks)

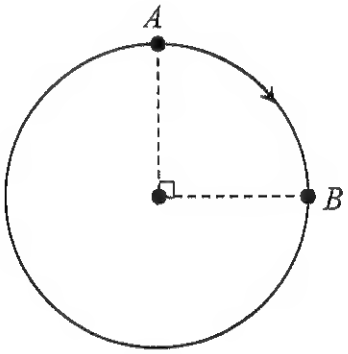

Figure 2 (a)

b) A disk having a radius of 0.15 m rotates with initial angular velocity of 2 rad/s and has a constant angular acceleration of 1 rad/s^2. When $t = 2$ s, determine

i) the magnitudes of the velocity,

[4 marks]

ii) the magnitude of acceleration of a point on the rim of the disk.

[6 marks]

Continued ...

QUESTION 3 (20%)

Figure 3 depicts a 50 kg satellite at point *A*. Its distance from the center of the Earth is 1.5×10^9 m. Given the mass of the Sun is 2×10^{30} kg, mass of the Earth is 6×10^{24} kg and distance between the Earth and the Sun is 1.5×10^{11} m. Calculate

a) the gravitational pull of the Earth on the satellite.

(4 marks)

b) the gravitational pull of the Sun on the satellite.

(4 marks)

c) the magnitude and the direction of the resultant force of the satellite.

(4 marks)

d) the acceleration of the satellite.

(3 marks)

e) the period of the satellite orbits the Sun to the nearest year.

(5 marks)

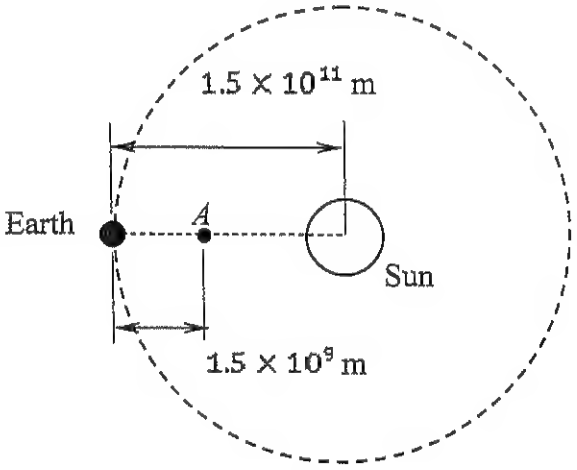

Figure 3

Continued ...

QUESTION 4 (20%)

Figure 4 shows a wire of length 0.5 m is fixed horizontally between two supports at 0.5 m apart. When a mass of 7.5 kg hung onto midpoint of the line, the wire sags by 10 mm.

a) Find the total extension of the wire.

(5 marks)

b) Express the tension, T, of the wire in terms of mass, m, gravity, g, and angle, θ.

(5 marks)

c) Given the diameter of the wire is 2.8 mm, what is the Young's modulus of the wire?

(10 marks)

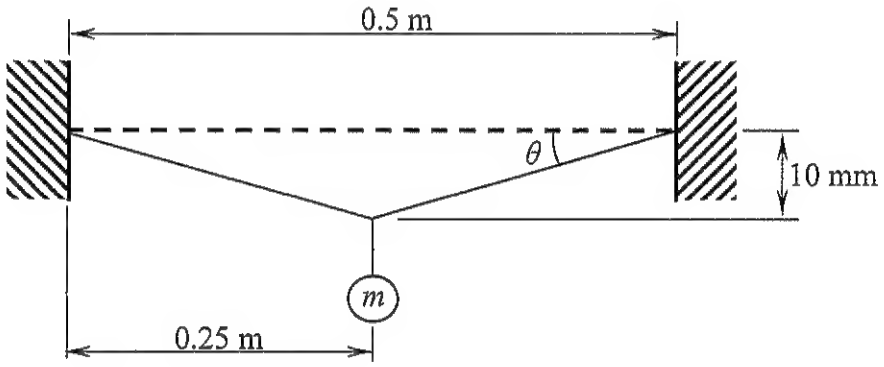

Figure 4

QUESTION 5 (20%)

A 50.0 g object connected to a spring with a spring constant of 35.0 N/m oscillates on a horizontal, frictionless surface with amplitude of 4.00 cm. Find

(a) The total energy of the system,

(4 marks)

(b) The speed of the object when its position is 1.00 cm.

(6 marks)

(c) The kinetic energy of the object when its position is 3.00 cm.

(6 marks)

(d) The potential energy stored in the spring when the position of the object is 3.00 cm.

(4 marks)

Continued ...

APPENDIX 1

Physical Constants

Quantity	Symbol	Value
Electron mass	m_e	9.11×10^{-31} kg
Proton mass,	m_p	1.67×10^{-27} kg
Elementary charge	e	1.602×10^{-19} C
Gravitational constant	G	6.67×10^{-11} N.m^2 /kg^2
Gas constant	R	8.314 J/K.mol
Hydrogen ground state	E_o	-13.6 eV
Boltzmann's constant	k_B	1.38×10^{-23} J/K
Compton wavelength	λ_c	2.426×10^{-12} m
Planck's constant	h	6.626×10^{-34} J.s
Speed of light in vacuum	c	3.0×10^8 m/s
Rydberg constant	R_H	1.097×10^7 m^{-1}
Acceleration due to gravity,	g	9.8 m /s^2
Atomic mass unit (1u)	u	1.66×10^{-27} kg
Avogadro's number	N_A	6.023×10^{23} mol^{-1}
Threshold of intensity of hearing	I_o	1.0×10^{-12} W /m^2
Coulomb constant	k	9.0×10^9 N m^2 /C^2
Permittivity of free space	ϵ_o/κ_o	8.85×10^{-12} C^2/N.m^2
Permeability of free space	μ_o	$4\pi \times 10^{-7}$ H/m

Energy equivalent of atomic mass unit:

One atomic mass unit (1.0 u) is equivalent to 931.5 MeV

Earth:

Gravity	=	9.8 m/s^2
Radius	=	6.4×10^6 m
Mass	=	6.0×10^{24} kg

Moon:

Mass	=	7.4×10^{22} kg
Radius	=	1.7×10^6 m

Sun:

Mass	=	2.0×10^{30} kg
Radius	=	6.96×10^8 m

Mean distance from:

Sun to Earth	=	1.50×10^{11} m
Moon to Earth	=	3.85×10^8 m

Continued…

APPENDIX 2

List of formulas

$$y = kx^n \qquad \frac{dy}{dx} = knx^{n-1}$$

$$\sin\theta = \frac{\text{opposite}}{\text{hypotenuse}} \qquad \cos\theta = \frac{\text{adjacent}}{\text{hypotenuse}} \qquad \tan\theta = \frac{\text{opposite}}{\text{adjacent}}$$

$$\sin\alpha + \sin\beta = 2\cos\left(\frac{\alpha-\beta}{2}\right)\sin\left(\frac{\alpha+\beta}{2}\right)$$

$$\sin(\alpha-\beta) + \sin(\alpha+\beta) = 2\sin\alpha\cos\beta$$

$$v = v_o + gt \qquad y - y_o = v_o t + \frac{1}{2}gt^2 \qquad v^2 = v_o^2 + 2g(y - y_o)$$

$$y - y_o = \left(\frac{v_o + v}{2}\right)t$$

$$a_c = \frac{v^2}{r} \qquad F_g = G\frac{m_1 m_2}{r^2} \qquad U_g = -G\frac{m_1 m_2}{r} \qquad T^2 = K_s r^3$$

$$\tau = r \times F \qquad \sum\tau = \tau_{net} = I\alpha \qquad I = \sum mr^2$$

$$v = r\omega$$

$$L = r \times p = I\omega \qquad K = \frac{1}{2}I\omega^2 \qquad |\tau| = |r||F|\sin\theta$$

$$T_s = 2\pi\sqrt{\frac{m}{k}} \qquad T_p = 2\pi\sqrt{\frac{l}{g}} \qquad T = \frac{2\pi}{\omega} = \frac{1}{f} \qquad \bar{y} = \frac{\sum_{i=1}^{N} m_i y_i}{\sum_{i=1}^{N} m_i}$$

$x = A\cos\omega t$ $\qquad$ $x = A\sin\omega t$

$v = -\omega A\sin\omega t$ $\qquad$ $v = \omega A\cos\omega t$ $\qquad W_F = |r||F|\cos\theta$

$a = -\omega^2 A\cos\omega t$ $\qquad$ $a = -\omega^2 A\sin\omega t$

$$v = \frac{\Delta x}{\Delta t} \qquad a = \frac{\Delta v}{\Delta t}$$

$$v = v_o + at \qquad x - x_o = v_o t + \frac{1}{2}at^2 \qquad v^2 = v_o^2 + 2a(x - x_o) \qquad x - x_o = \left(\frac{v_o + v}{2}\right)t$$

$$W = mg \qquad \sum F = F_{net} = ma \qquad f_s \le \mu_s F_N \qquad f_k = \mu_K F_N$$

$$p = mv \qquad \sum F = \frac{\Delta p}{\Delta t} \qquad \Sigma W = \frac{1}{2}mv^2 - \frac{1}{2}mu^2$$

$$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2 \qquad m_1u_1 + m_2u_2 = (m_1 + m_2)v \qquad P = \frac{W}{t} = \frac{E}{t} = \frac{Fd}{t} = F\bar{v}$$

$$K = \frac{1}{2}mv^2 \qquad PE_s = \frac{1}{2}kx^2 \qquad F_s = -kx \qquad PE_g = mgy$$

$$\bar{x} = \frac{\sum_{i=1}^{N} m_i x_i}{\sum_{i=1}^{N} m_i} \qquad W_{Fs} = \frac{1}{2}kx_i^2 - \frac{1}{2}kx_f^2$$

End of Paper.